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"Space Shuttle Program Update on STS-121"

SPEAKERS:

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WAYNE HALE, Manager, Space Shuttle Program
BILL GERSTENMAIER, Associate Administrator, Space Operations
KEN WELZYN, External Tank Chief Engineer

[Moderated by Dean Acosta]

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P R O C E E D I N G S

MR. ACOSTA: Good morning. Welcome from Headquarters here in Washington, D.C., for today's Space Shuttle Update. Today's participants include NASA Administrator Michael Griffin, Space Operations Associate Administrator Bill Gerstenmaier. From the Marshall Space Flight Center in Huntsville, Alabama, we have Space Shuttle Program Manager Wayne Hale and External Tank Chief Engineer Ken Welzyn.

We will have some short opening remarks followed by some questions and answers, starting here in Washington first, and then we will go around to reporters at the centers.

As is customary, please identify yourself and your organization before asking your question and also address whoever you are asking your question to as well.

As another reminder, please turn off all cell phones and blackberries before we get started.

All right. It is now my pleasure to introduce NASA Administrator Mike Griffin.

ADMINISTRATOR GRIFFIN: Thanks, Dean. [Inaudible] want us all to hear from first is Wayne.

MR. ACOSTA: Okay.

ADMINISTRATOR GRIFFIN: I'm primarily here for top-level issues, and if we get one of those, I'll handle it.

MR. ACOSTA: All right. Wayne, we will go to you first, and let's hear your opening remarks.

MR. HALE: Thank you, and good morning, everybody. I appreciate the interest and the turnout that we have had here to discuss the status of the Space Shuttle, and I want to start out by saying that we have celebrated the twenty-fifth anniversary of the Space Shuttle just a few days ago, and it is a remarkable thing to think about, all of the folks that worked to design this incredible vehicle, 30 years ago, to its first maiden flight, 25 years ago, and all the incredible activities that we have been able to do in space because we have this wonderful machine.

But as you know, we do have a serious concern with debris, particularly debris coming off the external tank and the foam that can come off the tank. It was clearly something that we had not carefully considered before the Columbia accident or as carefully as we should

have, and we have spent this past considerable period of time working to make the debris situation, the potential for liberation of foam off of the tank, as small as we possibly can.

I am reminded of the words of Dr. Diane Vaughan who talked about NASA in a book about an earlier problem that we had that foam is, in her definition, "an unruly technology," and what she meant by that and what I understand that she meant by that is that it is not well understood in the way that we understand metals and some other aspects of engineering. It is a science, the understanding of the mechanical properties of foam. Insulation is something that we are going to be working on for some time.

What we have done in the Space Shuttle Program is to take a look at our largest potential areas of threat from foam loss and attach each one of them. Clearly, the first area to work on was the 1.6 pounds of foam that we lost during the Columbia launch that caused that accident. We have eliminated the bipod ramps off the outside of the external tank, so that there is no continued threat from that large piece of foam.

We made improvements in a number of areas and then decided to fly what we have termed our "first of two test flights," STS-114, to see if we had, in fact, done enough to mitigate foam loss, and as you frequently do in test flights, we found that there was another mechanism that we had not considered, another opportunity to lose foam that we should address when we lost a just-over-one-pound piece of foam off what we call the protuberance airload ramp, the PAL ramp, and the pass several months, we had been working very hard to eliminate that ramp and make sure that we can fly without that large piece of foam.

That change constitutes the largest aerodynamic change that we have made to the Space Shuttle launch system since it first flew, and we are approaching that with a great deal of care, doing the work necessary to prove that the aerodynamics will still be good, that we have not introduced an aerodynamic loads problem that could cause the structure underlying to come to grief. That is a very intricate process, and that still faces us for our next flight, and we will be working on ensuring that the removal of the PAL ramp was a safe thing to do, almost up to the

Flight Readiness Review. We expect to have our final report out of the loads assessment people and the aerodynamics people just before the Flight Readiness Review.

At the same time, we know that past the PAL ramp, there is further work we would like to do on the tank. There are more areas where we have seen historically foam loss, and yesterday -- or I should say that we know the next largest area that we are concerned about is something called "ice frost ramps," which I have got a model of and we will talk about in a minute, and some months ago, we determined that if we were going to modify the ice frost ramps during this preparation for the STS-121 flight, that the appropriate time to modify those ice frost ramps would be the first week in May.

Every Thursday, we have programmatic review board, and we had pencilled in sometime back, April 27th as being the date that we would review whether it is appropriate or not to make a change to the ice frost ramps.

We had that review yesterday. It was an outstanding review. It represented the culmination of work of literally hundreds of people, many, many tests, many

designs. Some of you had been following the work that's been going on in the wind tunnels around the country where we have put some of these test articles to see how they will work out, and we reached a conclusion yesterday that it was mixed conclusion, as many of the decisions that are brought to the program manager's desk are.

There are folks that have opinions on both sides, people that come from strong technical backgrounds and give me and the other management team great advice, and yesterday was a typical day in that we got some mixed recommendations and made a decision.

Let me talk a little bit about what we've got. On my left, your right, here is a test article that has got one of the ice frost ramps in a test configuration where we have been using it here at the Marshall Space Flight Center to see the effects on the back side of this piece-part model. Cryogenic liquids helium is normally introduced, so that we can see how the foam will react to that, whether it will keep ice from forming, whether it will crack, whether other things might happen.

These ramps are spread out over the rank, and by way of background, we have over 4,000 pounds of foam

insulating the external tank. About three-quarters of that is robotically sprayed onto the outside of the tank. About one-quarter of that foam is applied manually. These ice frost ramps are applied manually.

I have a scale model which perhaps shows even better. On the outside of the tank, looking at the tank in the vertical, we have the big 17-inch LOX line, liquid oxygen line, coming down to the right, and then we have the other protuberances. Remember, we talked about the protuberance airload ramp.

We have a cable tray that carries instrumentation from the bottom to the top of the tank. We have two pressurization lines, one for the hydrogen and one for the oxygen, that run from the engines in the Space Shuttle orbiter up to the top of those two tanks to keep them pressurized during flight.

All of these things are connected to the underlying aluminum tank with metal brackets, and if that metal were uninsulated in the warm and humid environment in Florida, ice would form, and that would be unacceptable to us. So we apply foam to the outside of those brackets.

Historically, we have seen as much as 2- or

3-ounce pieces of foam come off these brackets, these "ice frost ramps" as we call them. We have been trying very hard to come up with a shape that will not lose foam, but will at the same time insulate these brackets. That work is still ongoing.

The decision that we had to come to yesterday was a question of whether it is appropriate to make more than one major change to the aerodynamic outer shell of the vehicle.

When we came right down to it, the recommendation that I came to and provided to the Administrator and to the Associate Administration is that we are in a flight test program, classical flight test if you look at aircraft or other experimental vehicles. When you make a major change, you should fly that major change without other major changes to see how it performed, and then if you have subsequent changes to be made, you make those in subsequent flights.

The reason we had such an interesting discussion -- and I would say that it was not outside the usual kind of interesting discussion we have at our requirements board -- is because there is a foam loss that we have seen and we

will expect to see off of the ice frost ramps on the next flight. It is not without risk to fly these ice frost ramps as they exist.

There was a strong concerted opinion from several folks that we should wait until we have a good design on these pieces of foam and then change them as well before we go fly. That is not without merit, and we considered it very strongly. However, at the end of the day, we came back to the fact that it is more appropriate to make one change at a time, to take care of the biggest problem that we have, and then work our way to the next situation that we would like to improve, and I expect that will be the story of the external tank for the remainder of the life of the Space Shuttle Program.

I surely hope and plan that the next vehicle that we as an agency make will have eliminated this kind of concern in its basic design and we won't have to worry about it. Clearly, they will have plenty of challenges as they go on to the Moon that will involve risk decisions in the future as well.

So, at the end of the day yesterday, the decision going forward was to fly, leaving these ice frost ramps as

is, knowing that we will expect to have some small foam loss that could pose a risk to us, or occur during the next flight or maybe two, while we continue to investigate how well our major aerodynamic change performs, and then we will proceed to deal with these smaller areas of foam loss.

That is about all I have to say, and I will ask if anybody else has an opening statement or if we are ready to go to questions.

MR. ACOSTA: Gerst?

MR. GERSTENMAIER: I think Wayne has covered it really well. I think he described the discussions that we got a chance to hear and see the work that the team has done over this period of time. I think it is a real tribute to the team that has pulled this work together.

You know, we started kind of last September with this overall plan of where we were going to do this testing and when the analysis was going to be complete, and through that entire period, all that work has been accomplished by the teams pretty much on schedule that allowed us to have this meeting yesterday to make this decision. So, if you look all the way back from September to where we are today, the teams have executed that plan through lots of problems.

The hurricane didn't help with all that, but the teams worked through all that stuff.

They continue to do a great job to bring us a good set of data yesterday. A tremendous amount of wind tunnel work has gone into this. I can't stress how hard they have worked in getting these wind tunnel tests done. They are not easy, to run these wind tunnel tests. It is not easy to understand this data.

The team did a phenomenal job to get all of this stuff together in as clean a format as we could hear yesterday from the team. So it was really a tribute to see this team perform and get ready to make a tough decision, but to get all of the data together and in place, it took multiple months and took a lot of personal work from a lot of folks, and I am really proud of Wayne and his team for doing this activity.

MR. ACOSTA: I have learned not to ask Mike if he has an opening statement. So we will go ahead and go straight to questions and answers. We will start here in Washington, D.C.

Again, I ask that you identify yourself and your organization before asking your questions, and then we will

go to other centers around the country.

All right. We will go ahead and start off with Guy.

QUESTIONER: Guy Gugliotta from The Washington Post.

I guess for Wayne, does this mean that you have not up to now hit on a new design for the ice frost ramps that is an improvement over the old design?

MR. HALE: We have been working very diligently -- I should say the folks particularly here at Marshall Space Flight Center, along with our Lockheed Martin contractors that build the external tank for us, have been working extremely hard to come up with a new shape for the ice frost ramps that provides both of the characteristics that we desire, which is to say does not form ice during the time that we are sitting on the launch pad with the cryogenics present and also will hold together and not shed foam for any reason during the launch phase as we accelerate to supersonic speeds through the lower atmosphere.

That is not an easy process. We do not have the perfect or final design in place today. There are a couple

of conceptual designs. Great progress is being made. I expect in the next month to 6 weeks, we will come forward with a really good design that we will implement on subsequent tanks.

MR. ACOSTA: All right. Next question, Keith.

QUESTIONER: Keith Cowing, NASAwatch.com, for Wayne.

I have gotten some really interesting feedback from people in and around this meeting. Some thought you were too conservative in making this decision. Some thought you were being risky. Some thought it was great that you finally just, you know, have a process in place where you can listen to the hardware, so to speak, and just make a decision. Others thought that you didn't put the time into it.

This has been a long path since you have been sitting in this position, answering this question, but do you feel that schedule pressure is still there, or has it morphed into something that you can at least cut off in pieces and chew a little bit better?

MR. HALE: Well, you know, I'm mindful of the fact, we just had a big project management conference in

NASA, and it got reemphasized to us that a good project or program manager does have to consider cost and schedule along with the technical performance that he is trying to achieve, that the program or project is trying to achieve.

In this particular instance, however, I felt that this was an important enough decision that we should divorce cost and schedule from this decision and make it on purely technical grounds and then deal with the fallout.

We have a schedule. It is important to have a schedule. We intend to complete the International Space Station in the next 4-1/2 years, but that didn't drive this particular discussion, and we are trying to make appropriate decisions in light of the schedule and not let it drive us to overly risky or foolish decisions just to make a schedule that we know has some time in it to allow for engineering problems to be solved.

MR. ACOSTA: All right. We will take one more question here in Washington, and then we will go to JSC. We will go to Beth.

QUESTIONER: Beth Dickey with Government Executive.

Given that you have now got one more foam issue

to deal with after you fly the next flight, for any of the three of you, is this going to alter the plan to have two flights as a return-to-flight test, or might you add a third now?

MR. HALE: Beth, we're going to take this one step at a time, and we currently have plans to launch the next two flights, so that they have full daylight coverage, so that we can get the best data back from the tank to see how the foam performed. We will make that decision following the next flight or two to see how we are doing.

After that, we also have the radar, which is tracking any debris that might be shed off the vehicle. You know, we made quite a sizeable investment in considerable new radar that can do quite an interesting job of finding small things that come off the launch vehicle, and we have new cameras that are oriented in a direction where we -- some people believe at least that the light from the solid rocket boosters would provide sufficient illumination to still have good visual evidence through what we call "first stage" or the first 2 minutes of Shuttle flight to see what is going on. So we are going to see where the data leads us.

Obviously, it is in the interest of getting on with Space Station assembly to be able to return to night launch operations, and that is where we would like to get, but we will measure that one flight at a time.

MR. ACOSTA: All right. Let's go to the Johnson Space Center in Houston for a couple questions.

QUESTIONER: This is Mark Carreau from the Houston Chronicle.

Could you explain the number of ice frost ramps that are really on the tank and how many of them, if not all of them, that you are really concerned about?

MR. HALE: I hate to say it, but here in Huntsville, we could not hear the question. It was very low.

MR. ACOSTA: Sure. I will read the question, Wayne. The question was can you explain how many ice frost ramps are on the vehicle or on the external tank and what the --

PARTICIPANT: How many of those are you concerned with.

MR. ACOSTA: Yeah. And how many of those are you concerned with.

MR. HALE: Ken -- I brought him to the press conference. We need to let him answer one question.

So, Ken, I will let you take that.

MR. WELZYN: Okay. There are a total of 34 ice frost ramps on the external tank. There are, I believe, 12 on the liquid oxygen tank and 16 on the liquid hydrogen tank, and I believe the balance is on the inner tank.

The main concern that we have from a debris standpoint turns out to be about the top four on the hydrogen tank. These are in an area where thermally they warm up as the liquid level drains from the tank during the time of flight when debris poses a risk to the Shuttle.

Obviously, we are concerned about foam loss from all of them, but those are the ones that are primary concern for us.

MR. ACOSTA: All right, Mark?

[No response.]

MR. ACOSTA: Next question from Johnson?

QUESTIONER: This is Mark Carreau. I'm sorry we didn't hear anything, but let me ask a follow-up. What is the expected mass and the allowable mass of foam loss that you are going to work with on this next mission?

MR. ACOSTA: That sounded like Charlie Brown's teacher asking a question. I think we may have to repeat that one.

All right. We are going to come back to Washington and see if we can work out some of those bugs of those questions. We will go to Jeff Morris over here.

QUESTIONER: Hi. Jeff Morris with Aerospace Daily, I guess for Wayne or Ken.

You said 2- to 3-ounce pieces historically of foam have been observed coming off. I was just wondering what is kind of the worst-case scenario of damage that a piece that size or maybe multiple pieces could do.

MR. HALE: Our aerodynamics folks and materiel science folks tell us that the worst case, if it came off with the maximum mass, which would be on the order of 3 or 3-1/2 ounces, and comes off at the worst time and follows the worst-possible trajectory to the most vulnerable part of the orbiter, it would not be what we would like to have. I don't know how to characterize it more than that. It would cause what we call "critical damage."

So our goal is to eliminate or mitigate -- thank you. That's the word I was thinking of. To mitigate that

hazard to the maximum extent that we possibly can, and we intend to do that, and you know, once we deal with the ice frost ramps, then we are going to move on to the next area of the tank that we are concerned about that is potentially shedding even smaller pieces and work on that one. So this will be a continuous improvement process throughout the life of the program.

MR. ACOSTA: All right. Now we are going to go to Marshall Space Flight Center where Wayne is to get a couple of questions.

QUESTIONER: Hi. This is Shelby Spires with the Huntsville Times, and this question is either for the Administrator or Wayne.

Wayne, you mentioned that you are committed to finishing or completing the International Space Station, but given that there is 3-1/2, 4 years left, do you think you will make the flight rate? Is that flight rate that has been reported of 16 to 18 flights doable, and is the 2010 date still the retirement date for the Shuttle, or is that a solid date?

MR. HALE: I am going to take the easy part of that first and tell you that, yes, that number of flights

in the next 4-1/2 years is immanently doable and well within the kind of flight rate that the Shuttle has provided the Nation before. So I am very optimistic that we can complete the International Space Station in the time that we have been asked to do it, and we will have to be very diligent in looking at this aging vehicle and make sure that it is safe to fly every time we get ready to go fly it, but I think we have the resources and the capability to do that.

ADMINISTRATOR GRIFFIN: And I will pick up my piece of that. The short answer is, yes, 2010 is a firm date.

Let me expand a little bit on the reasons for that. If this program, if the Space Shuttle program were of a nature that it was dominated by the variable cost of flight, the cost of flying each individual flight, then the right thing to do would be to plan a certain number of flights for budgetary purposes and execute that number because then we would have known budgetary requirements and we would be done, but this is a program whose marginal cost of flight is actually quite reasonable, but for which the fixed costs of ownership are quite high and variously, you

know, known to be about $4.5 billion a year.

So we at NASA, we, in fact, in the Federal Government, cannot do budgetary planning for this program unless we pick a date when we will be done with it. We have to pick a year that will be the last year we will fly Shuttle flights and stick with that, and that is what we are doing, and those are the reasons.

MR. ACOSTA: All right. Let's come back to Washington here and see if there are any follow-up questions. Let's go to Guy.

QUESTIONER: Guy Gugliotta again from The Washington Post for Wayne.

How has the removal of the PAL ramp affected the performance of the ice frost ramps, if at all?

MR. HALE: That is exactly the kind of question, not just the ice frost ramp performance, but all the other areas of the external tank and, in fact, the integrated stack with the orbiter and the solid rocket boosters on it that we are looking at.

Clearly, there are increased aerodynamic loads on some structural elements. In particular, we talked about the protuberances, that the PAL ramp was put on there to

provide some aerodynamic relief from. So the principal things we are concerned about is the cable tray and the attached brackets that underlie that cable tray and how they fit onto the skin of the tank and these two pressurization lines and, in fact, the big 17-inch liquid oxygen line as well. So that is exactly the kind of analysis that has gone forward to demonstrate both the wind tunnels computational fluid dynamics and structural analysis that those parts will hold together under increased load because, without the PAL ramp, there will be increased loading, and, in fact, we are looking at the whole integrated structure, solid rocket booster attachment points, the orbiter, and all other areas to ensure that we have not introduced some unanticipated consequence that would be untoward.

So the performance of the overall vehicle has got to be satisfactory from a mechanical and structural standpoint. That, we have yet to complete the analysis on.

In terms of other performance, the good news is that is about 37 pounds of weight that we no longer will be carrying to orbit that we can devote to additional supplies to the International Space Station, for example.

MR. ACOSTA: Gerst, did you want to follow that?

MR. GERSTENMAIER: I would add one thing to that. In the discussion that I listened to yesterday, we are really kind of pushing this state-of-the-art over analysis and wind tunnel capabilities throughout the country. There is not really one wind tunnel where you can simulate all the proper conditions that are going on with the tank. There is not really one test facility where you can simulate all these things that come together in a Shuttle launch.

The tank expands when it is pressurized. It contracts when it is cooled down. The vibration from the solid rocket motors cause vibration through the tank structure which go through the bracketry, those press lines that Wayne showed you. Those have fluid or gasses flowing through them. They are moving up and down. They are dynamically moving in and out. All of that is tremendously difficult to simulate in our test facilities and to put together in computational flight dynamics.

So, at some point, you really need to go to flight, and you need to go to flight with some instrumentation, so you can monitor that performance and

see how the device and design you put together with the best of your engineering capabilities actually performs in flight, and that is exactly what we are doing here.

We are going to have some new cameras on the solid rocket boosters that we can look at these areas. We should be able to see the ice frost ramps. We should be able to see the small foam liberation that we expect to see come off, and then that data is going to be invaluable to go back and improve our wind tunnel models and improve our computational fluid dynamics and take a piece-wise incremental step in the improvement in the design.

So we continue to monitor on each flight. We take all the data we can get from the flight. We put it together with all of our ground assets. We make the best decision, and we move incrementally better on each flight.

MR. ACOSTA: Zach or anybody else up front that wants to ask a question?

[No response.]

MR. ACOSTA: All right. Well, it looks like we are going to be wrapping up a little earlier today.

ADMINISTRATOR GRIFFIN: Anything back from Houston?

MR. ACOSTA: We do not. So thank you for asking, Mike.

Any closing remarks from Wayne?

MR. HALE: Just that we are continuing to work toward the July 1st launch opportunity. We have a huge amount of work ahead of us, but we have a good plan I think and we have many dedicated people that are working very hard here at the Marshall Space Flight Center. Kennedy Space Center, Johnson, and the other NASA centers around the agency have really stepped up to help us.

I particularly want to thank the folks at the Arnold Engineering Laboratories as well as Glenn Research Center and Ames Research Center where we have been doing all of this wonderful wind tunnel testing and using the super computers at the Ames Research Center to do our computational fluid dynamics work that makes all of this possible for us to feel confident when we go fly.

MR. ACOSTA: Thanks, Wayne.

Gerst?

MR. GERSTENMAIER: Nothing to add.

MR. ACOSTA: Okay. Mike?

ADMINISTRATOR GRIFFIN: No.

MR. ACOSTA: All right. Well, that is going to conclude today's Space Shuttle Update.

I would like to remind folks that 2:00 Eastern today, we are going to have the Exploration Workshop Media Telecon.

I think, Mike, you wanted to mention a little something about the Exploration Workshop that has been going on.

ADMINISTRATOR GRIFFIN: Yes. I haven't been able to attend it, but I keep getting reports that the people who are there are really pretty happy with it. This is following the release of our architectural blueprint, I guess I should say, for returning to the Moon. This is the first major conference or major event we have had where people can gather together and get to the interesting stuff which is what do we want to do when we get there.

When we don't have the transportation capability, which, of course, is where we are right now, all the focus has been on re-creating the lunar transportation system that we once had and doing so in a manner that will allow us to have the maximum transferability to Mars later on, and I think we have done that.

But the really interesting part is what do we do when we get off the Earth again for the first time in decades, and that is what this conference has been devoted to. We have had folks from industry and folks from other countries and folks from the program out there, and I am looking forward to hearing how that went at 2:00 myself.

MR. ACOSTA: That will be great.

Deputy Administrator Shana Dale along with Exploration Systems Mission Director, Deputy Doug Cooke, will be the participants in that media telecon. So we invite everybody here that is certainly here and out at the centers that want to take part to take part in today's telecon, which will also be streamed on NASA.gov.

All right. That is going to do it for today's Space Shuttle Update. We thank you for joining us, and have a great afternoon.

[End of Space Shuttle Program Update on STS-121.]

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